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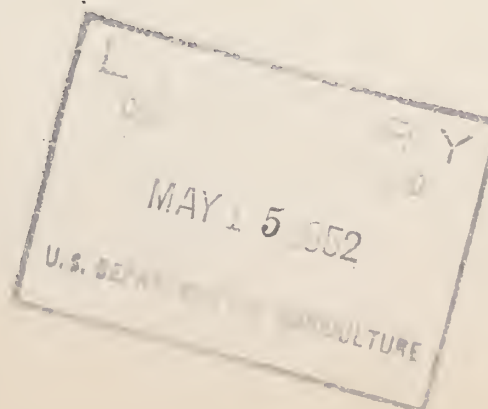
X STORAGE TESTS WITH FLORIDA GRAPEFRUIT, 1951
ORLANDO, FLORIDA, AND NEW YORK, N. Y.

By

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Division of Handling, Transportation and Storage
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THE STORAGE OF FLORIDA GRAPEFRUIT
ORLANDO, FLORIDA, AND NEW YORK, N. Y.
1951

This is a report of the 1951 storage experiments with April and May-pick Duncan and Marsh seedless grapefruit, conducted at Orlando, Florida, and New York, New York. The tests were a part of the investigations on the storage of citrus fruits conducted by the Bureau of Plant Industry, Soils, and Agricultural Engineering, and The Refrigeration Research Foundation.

SUMMARY

Storage investigations were conducted at Orlando, Florida, and New York, New York, on Florida grown Duncan and Marsh seedless grapefruit. At Orlando, the storage temperatures were 32° and 50° F., whereas at New York they were at 32°, 38°, 45°, 50°, and 55° F. The relative humidity in the storage rooms ranged from 80 to 90 percent. The storage tests were designed to ascertain the keeping quality of fruit picked in April and about a month later, in May.

The fruit used in these tests proved to be extremely subject to decay and no clear cut conclusions can be made regarding the differences in storage behavior of April vs. May-pick or between fruits of the Duncan and Marsh varieties. The grapefruits when removed from storage held up fairly well for three days at 70°, but developed considerable decay by seven days. Where pitting occurred it was worse at 38° than at lower or higher temperatures. Where pitting was not important at inspections made at the end of a four weeks' storage period, best results were secured from storage at 32° or 38°, however, where pitting occurred the best over all results were at 45° or 50° storage.

Storage for eight weeks was completely unsuccessful because of the serious amount of pitting at 32° and 38° F. and the prevalence of decay at all storage temperatures. The results showed that decay developed very rapidly during the holding test period of 70° F. following storage.

Records were taken on twelve commercial carlots of grapefruit that were stored either at Newark, N. J., or Providence, R. I. Storage temperatures were approximately 32° F., and the storage period averaged about four weeks. The results

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indicate that because of prices the commercial storage was unsuccessful. The condition of the fruit in five cars at the time of removal from storage was rated as fair to poor to very poor, chiefly because of the prevalence of decay. However, the fruit in four of the five cars was found to be in poor or very poor condition at the time it entered storage. These findings should suggest the importance of careful handling in the packinghouse, refrigerated transit, and storing only strong fruit of high quality. These suggestions should be followed even though the sales price is low as was the situation during 1951 when the commercial cars were shipped.

MATERIAL AND METHODS

Storage studies on Florida grapefruit were conducted at Orlando, Florida, and New York, New York. The tests were with the Duncan and Marsh seedless varieties and they were grown on rough lemon rootstock in a grove located at Orlando. Packinghouse treatments consisted of washing, waxing, polishing, and packing of fruit in Bruce boxes with phenodor liners. At Orlando, the storage temperatures were 32° and 50° F., while at New York, storages were at 32°, 38°, 45°, 50°, and 55° F., and 85 to 90 percent relative humidity. The test boxes were shipped to New York along with commercial shipments under standard refrigeration. For example, the first picking of Duncan and Marsh fruits were shipped from Orlando, April 18 and 19. They were placed in storage at New York, April 25. Fruit temperatures at the time of unloading ranged between 38° to 45° in the bottom and top doorway positions, respectively, in the Duncan car. Fruit temperatures ranges between 44° to 46° in the bottom and top doorway positions, respectively, in the Marsh car. The May-pick Duncan and Marsh grapefruits were shipped to New York, May 18, and were placed in storage, May 24. During transit, fruit temperatures dropped slowly from 74° to 66° F.

The studies at Orlando and New York were designed to determine the effect of various storage temperatures on the keeping quality of:

1. April-pick Duncan grapefruit
2. May-pick Duncan grapefruit
3. April-pick Marsh grapefruit
4. May-pick Marsh grapefruit

Each of the test lots at Orlando consisted of 15 packed boxes, while at New York where the storage facilities were greater each test lot consisted of 33 boxes. The potential keeping quality was determined by a seven-day holding test at 70°. The withdrawals from storage were made after four and eight weeks and each subsample consisted of 3 box lots.

The methods of procedure and of inspections of fruit were similar to those employed in the orange storage tests. (See H. T. & S. Office Report No. 266.) In scoring the several types of skin breakdown, a given fruit showing both aging and pitting was scored under the defect that was considered the more serious blemish. Decay was always considered more serious than any type of skin breakdown. Decayed fruits were scored under stem-end rot when the symptoms were characteristic of Diplodia or Phomopsis rot, even though the decay occurred elsewhere than at the stem end. Three inspections were made; namely, at the time the boxes were removed from storage, three days after removal, and seven days after removal. During this seven-day holding period the temperature was 70° F. and the relative humidity 70 to 90 percent.

The phenodor (diphenyl-treated) liners were removed at the first inspection. Decayed grapefruits were removed and discarded at the first and second inspections before repacking the sound fruit into the test boxes. The amount of decay for the second and third inspection is cumulative, that is, it includes decay counts for all previous inspections. Pitting and aging records at the second and third inspections are not cumulative, but instead, are based on actual counts made at the particular inspection. It should be noted that decays other than stem-end rot and Penicillium rot are not listed by specific types, but are included with total of decay in each instance. Thus, total of decay may be greater than the sum of stem-end rot and Penicillium rot.

RESULTS

Storage of April and May-picks of Duncan and Marsh Seedless Grapefruit at 32° and 50° F. at Orlando, Florida

At the Orlando station there were only two rooms available for the storage tests on grapefruit. One room was maintained at 32°, the other at 50° F. The results of the four weeks' storage are summarized by April and May-picks in Table 1. It will be noted that pitting and aging were of minor importance at 50° storage. Pitting and aging were greater in the fruits stored at 32°, with most of the skin breakdown occurring between the third and seventh day at 70° following the low temperature storage. Very little decay developed at 32° storage. However, it did develop to a serious extent during the holding period at 70° following storage. More decay developed at 50° than 32°, but when the results of the holding test period are considered, 50° proved more satisfactory than 32° storage. This point is made clearer by consideration of the total of decay at the end of the seven-day holding period following four weeks' storage. The April-pick at 32° storage showed 21.6 percent decay, while the April-pick at 50° storage showed 13.1 percent. The May-pick at 32° storage showed 45.6 percent, while the May-pick at 50° showed 23.9 percent. Similar relationships resulted from eight weeks' storage. However, it should be stated that greater amounts of pitting, aging, and total decay developed during the eight weeks' than the four weeks' storage period.

The comparative storage quality of Duncan and Marsh grapefruits are shown in Table 2. The results indicate that there was slightly more decay in the fruits of the Marsh variety than the Duncan. To be specific, the total decay after seven days at 70° following four weeks at 32° was 32.3 percent for the Duncan, and 34.9 percent for the Marsh; and after seven days at 70° following eight weeks' storage, total decay was 68.0 percent for the Duncan and 85.7 percent for the Marsh. Lower percentages of total decay were found in the lots stored at 50°, but nevertheless, decay developed to such an extent as to make the storage of the grapefruit impractical from a commercial standpoint.



Storage of April-Pick and May-Pick Duncan and Marsh Seedless
Grapefruit at Five Different Temperatures at
New York, N. Y.

The four test lots, namely April-pick Duncan, April-pick Marsh, May-pick Duncan, and May-pick Marsh, each consisted of thirty-three boxes. Three boxes of each lot were examined at arrival and six boxes stored at each of five temperatures, half of which were examined at the end of four weeks' storage, and half at the end of an eight weeks' storage period. The three replicate boxes per temperature for each inspection were of size 64, 70 and 80.

Five different storage temperatures were used, namely 32° (32°-34°), 38° (38°-40°), 45°, 50°, and 55° F. Relative humidities for the five rooms were, respectively, 90, 88, 82, 88, and 85 percent.

Inspections made on representative boxes of each of the four lots at the beginning of the storage period are summarized in Table 3. All held up well for three days at 70° F. However, by seven days at 70° decay closely approximated or slightly exceeded five percent except in the May pick-Marsh.

The results of four weeks' storage of April and May picked fruit are summarized in figure 1 and in table 4. In the April pick fruit pitting was more prevalent at 38° F. than at any other temperature. Taking into consideration both pitting and decay best results were obtained by storage at either 32°, 45°, or 50° when judged by data of the first inspection immediately following storage, and best results at 45° or 50° when judged by the data of the inspection after three days at 70°. So much decay had developed in all of the temperature lots by the seven-day inspection at 70° that there was little difference between them. The 38° lot showed an unusually high amount of skin breakdown at the seven-day inspection. In the May-pick lots pitting was of much less importance than in the April-pick. Since decay was much more prevalent at the three higher temperatures best results were secured by storage at 32° as judged by the first inspection, and 38° as judged by the three-day inspection. Decay became very serious in all temperature lots by the end of the seven-day holding period.

A summary of the four weeks' storage data is also presented by varieties in Figure 2 and in Table 5. Decay was serious in all lots by the end of the seven-day holding period. At the first and second inspections best results were secured by storage of Duncan at either 32° or 38°. With Marsh, best results were obtained by storage at 32°, 45°, or 50°, as judged by first inspection and by storage at 50° when judged by the data of the three-day inspection.

The results of eight weeks' storage are summarized by April-pick and May-pick in Figure 3 and in Table 6 and by varieties in Figure 4 and in Table 7. The serious prevalence of pitting at 32° and 38° and the great amount of decay that developed at 45°, 50°, and 55°, made storage of all lots impracticable for a period as long as eight weeks. The total of decay reached fantastic proportions in many lots at the second inspection and in all lots at the seven-day inspection. Much of the decay included in the total, but not specified as to type, was Oospora rot. Then, too, in many instances the fruit was in such an advanced stage of decomposition that no attempt was made to identify it.

The fact that the fruit used in the storage tests was so subject to decay makes it difficult to summarize the results. The differences between April-pick and May-pick fruit and between Duncan and Marsh have been pointed out under the discussion of the four weeks' storage results. It is questionable whether any general conclusions should be attempted on the basis of the differences mentioned. With regard to storage temperatures, where pitting developed it was more serious at 38° than at lower or higher temperatures, but was frequently important at 32°. A tentative conclusion might be that best storage results were secured at 45° or 50° F., with the latter temperature probably preferable.

Commercial-Carload Storage Tests

A study was made of twelve carloads held under commercial storage at New York City (Newark, N. J.) and Providence, R. I. The loads were handled in a strictly commercial manner, although as complete records as possible were taken between the time the fruit was packed and the time it was sold.

The fruit entered storage between April 23 to June 13, and was removed between May 22 to July 11, for an average storage period of four weeks at a temperature of about 32° F. and a relative humidity of 90 percent.

The development of pitting or aging during storage was not of great importance. It should be pointed out, however, that where decay was prevalent it may well have been initiated, in some instances at least, at weakened points on the rinds.

Decay was of considerable importance in some carloads. Wherever possible, inspections were made of the fruit while it was being removed from storage. Although it was not possible to follow a uniform system of inspection, an attempt was made to examine representative boxes at intervals during the storage period. Some inspections were made in storage or at the sales pier. At times boxes were examined at the laboratory after which the liners were removed and the fruit repacked and held at 70° F. for reinspection three and seven days later. Boxes from Providence were delivered to the New York Laboratory by overnight refrigerated motor truck service.

The results of the inspections are summarized along with other data in table 8. The condition of the fruit at the end of the storage period is recorded as either excellent, very good, good, fair, poor, or very poor, depending largely upon the prevalence of decay. Since relatively few packages were examined at any one inspection consideration was given to the results of all inspections as well as the final one in arriving at the condition designated. It may be pointed out, however, that in all instances where the condition was rated better than fair less than three percent decay was noted at the initial inspection after any period of storage. It will be noted that five of the twelve carloads were rated as in poorer condition than fair. It is of further interest to note that four of these five carloads were found to be in poor or very poor condition at the time of storage.

Sales price at the time of storage was \$2.53 per box, while at the end of storage, the sales price was \$2.29 per box. The five test cars of grapefruit sold on the New York auction at an average price of \$1.58 per box.

In conclusion, as judged by the sale prices received, storage could hardly have been profitable for the five cars sold at New York. The generally unsatisfactory condition of five of the twelve cars at the time they were removed from

storage at first glance suggests unfavorable results from storage. As already pointed out, however, four of the five cars were of undesirable condition at the time they were placed in storage. Perhaps the chief conclusion to be drawn from the results of the tests is that fruit which does not meet a rigid standard of inspection at arrival on the market should not be placed in storage even if so intended at the time of shipment.

Effect of Phenodor Liners on Decay of Fruit
in Storage and Cooling During Rail Shipment

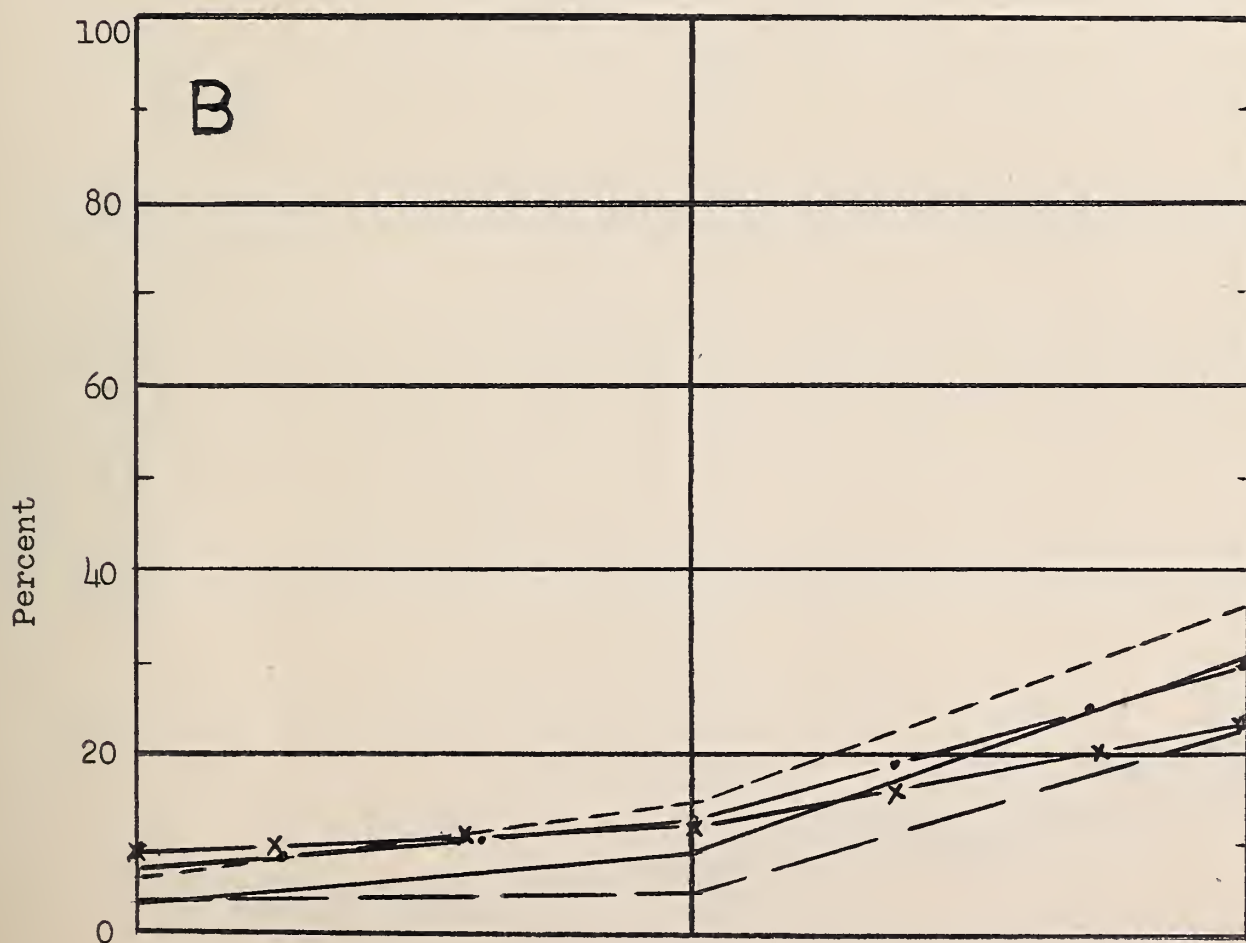
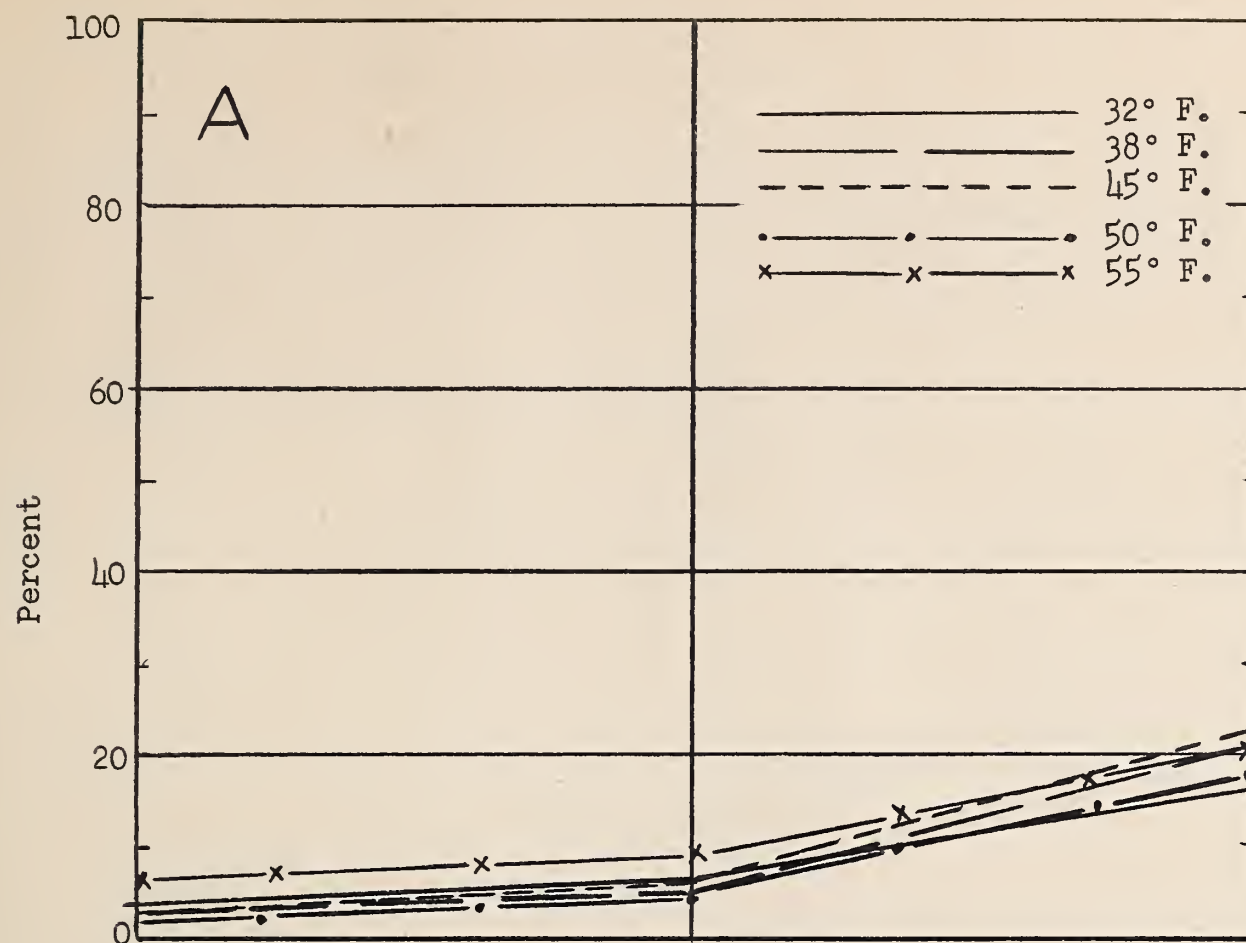
The fruit in all 12 cars of the commercial storage tests was packed in Bruce boxes. In most of the car lots the boxes were lined with phenodor liners, but in 3 cars some of the boxes were left unlined in order to compare these with lined boxes as to the relative amount of decay and rate of cooling, as will be described later.

In one of the cars (number 5 of Table 8) fifteen boxes were packed without liners. These together with fifteen boxes with liners were segregated for special observation. When inspected on arrival three boxes with liners averaged 9.1 percent decay, and 15.9 percent after three days at 70° F., and 21.3 percent after seven days, whereas the three boxes without liners averaged 4.3, 16.5 and 22.6 for the same inspections. It should be noted that the decay records for the three-day and seven-day inspections are cumulative. The remaining boxes (24) were stored at 50° F. for four weeks, at which time six boxes with liners averaged 37.2 percent at the time of withdrawal, and 46.3 percent after three days at 70° F. Because of the great amount of advanced decay the fruit was not held beyond three days. The six boxes without liners averaged 22.3 percent at the time of withdrawal and 32.6 at three days. The remaining twelve boxes were then immediately withdrawn and given only an initial inspection before terminating the test. An average of 31.7 percent decay was found in those with liners and 29.0 percent in those without liners. Most of the decay at all inspections was Penicillium rot. It will be noted that although decay was seriously present in both lots it was somewhat higher in the boxes with liners. It is only fair to point out that as shown in Table 8 car 5 was one of four that arrived in poor to very poor condition, thus indicating that the fruit was very weak and readily subject to spoilage.

Since the beneficial effects of phenodor liners for the control of Penicillium rot (blue-mold rot and green-mold rot) have been repeatedly demonstrated, the question arose why greater decay occurred in the boxes with liners. It was suspected that one explanation might be the slower rate of transit cooling in the lined boxes. Arrangements were therefore made for one-half of a commercial carload (number 12 of Table 8) to consist of boxes with phenodor liners and the other half of boxes without liners. Ryan recording thermometers were placed in the center of three boxes in the centerline of each half of the carload, namely at bottom bunker, middle quarterlength and top doorway positions respectively. The test shipment was made in a fan car. The load was precooled with the car fans for 20 hours and shipped under standard refrigeration. At the time of unloading, five days after shipment, manually-taken fruit temperatures averaged 46.9° F. in boxes with liners and 43.6° in boxes without liners. However, average transit temperatures as recorded by the recording thermometers were 16.5 degrees higher in liner boxes than in naked boxes at middle quarterlength position, 6.1 degrees higher at top doorway position, and 6.7 degrees higher at bottom bunker position. At the

time the car arrived for storage, decay averaged 3.4 percent in seven boxes with liners and 2.3 percent in seven boxes without liners. After four weeks' storage decay averaged 14.5 percent in six boxes with liners and only 4.3 percent in six boxes without liners. However, upon removing liners and holding all boxes at 70° F. average cumulative decay for both those originally with liners and those without liners had reached approximately 21 percent in two days and 50 percent in seven days. It will be noted from Table 8, that this carload was considered to be in fair to poor condition at time of storage.

Approximately half of the boxes in a third carload (number 9 of Table 8) were packed with phenodor liners and half without liners. No information was obtained as to their relative location in the car. On the basis of inspections made at arrival and at the end of three, five, and seven weeks' storage no significant difference in decay development or skin breakdown was noted between those with liners and those packed naked. The carload as a whole was considered to be in very good condition at time of storage.



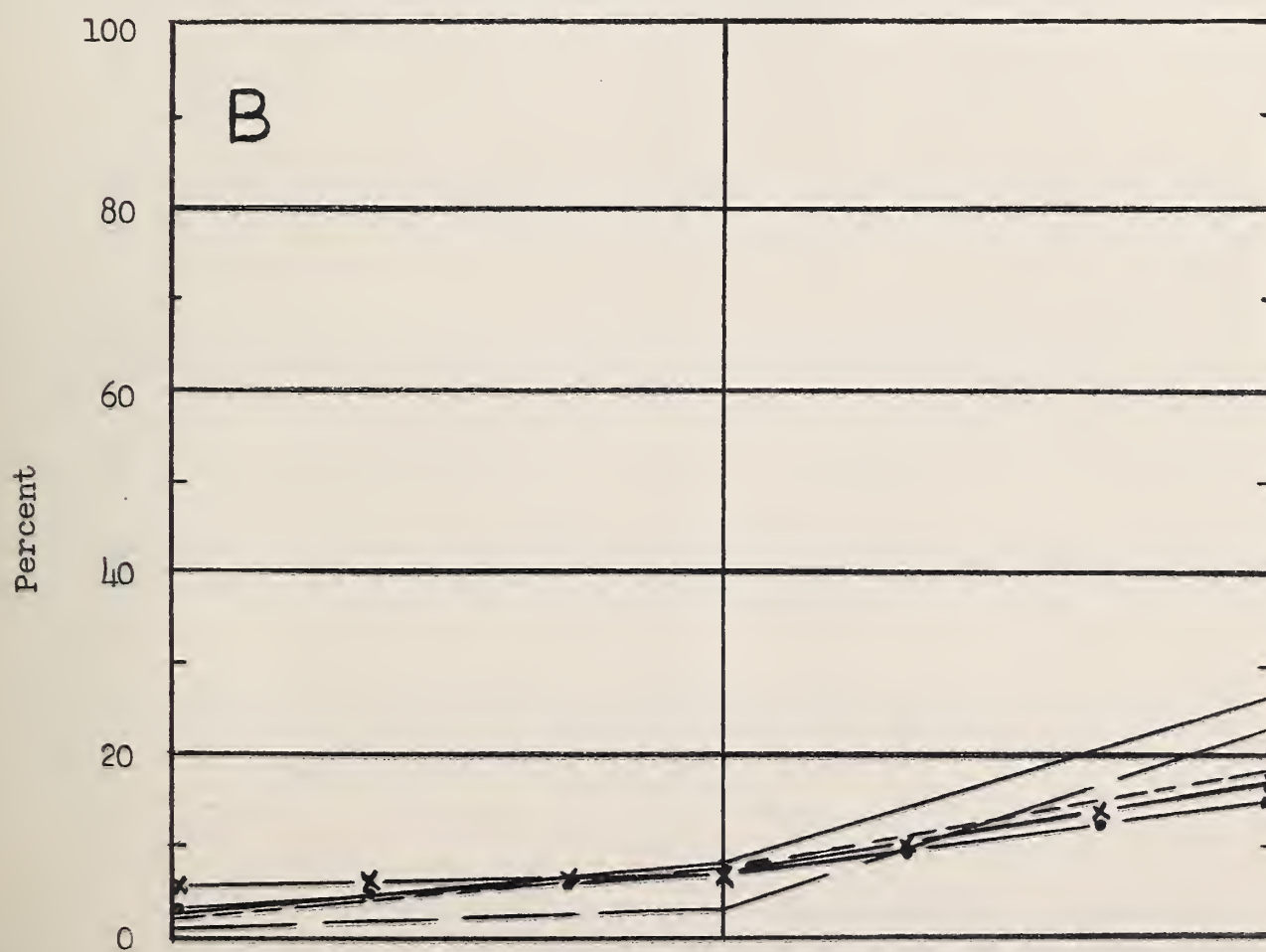
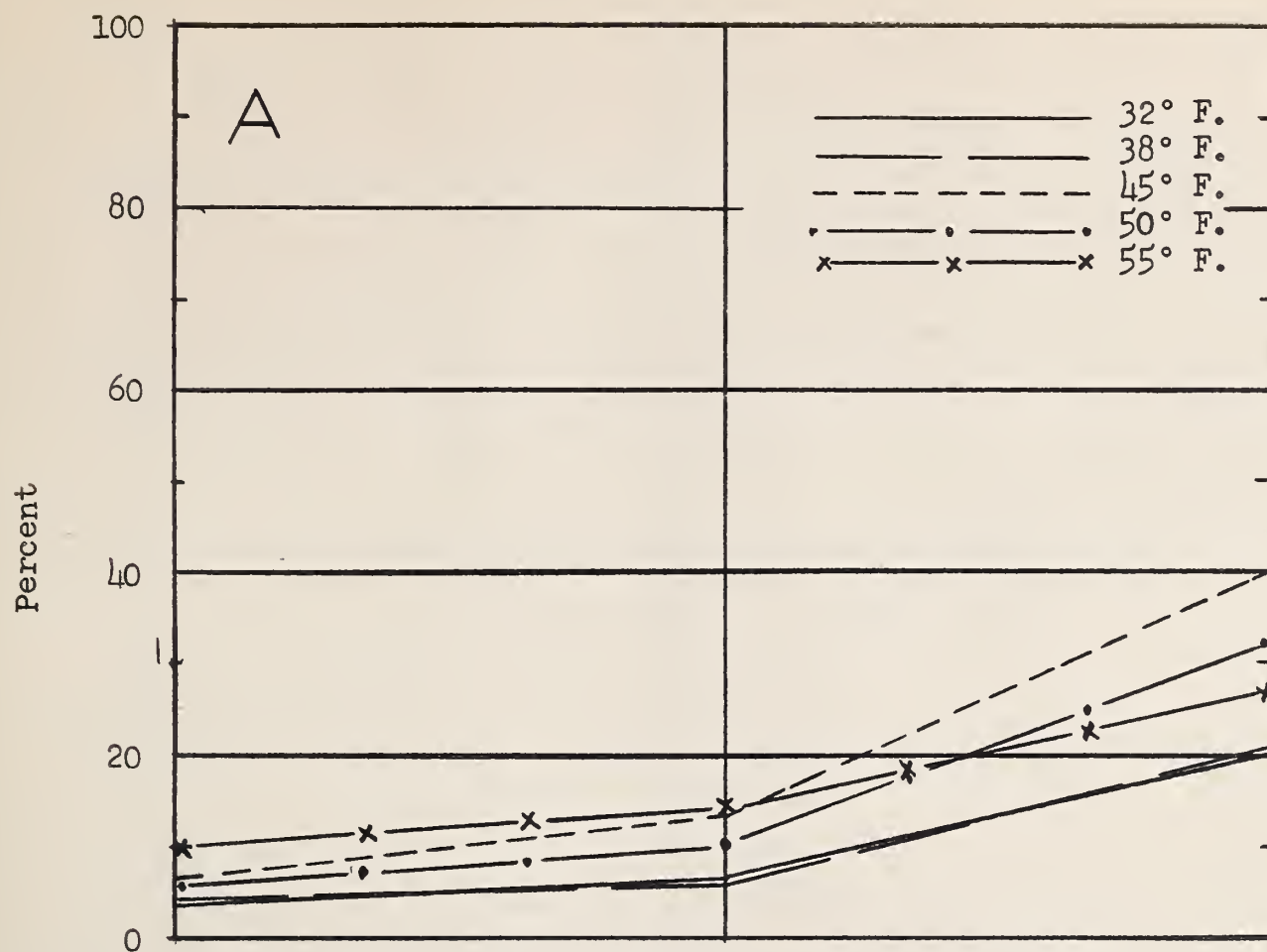
First inspection
After Storage

Second Inspection
3 Days at 70° F.

Third Inspection
7 Days at 70° F.

Figure 1. Effect of different storage temperatures on the development of decay during the holding period following 4 weeks' storage; A, April-picked Duncan and Marsh grapefruit; B, May-picked Duncan and Marsh grapefruit.





First Inspection
After Storage

Second Inspection
3 Days at 70° F.

Third Inspection
7 Days at 70° F.

Figure 2. Effect of different storage temperatures on the development of decay during the holding period following 4 weeks' storage: A, Duncan grapefruit picked in April and in May; B, Marsh grapefruit picked in April and in May.

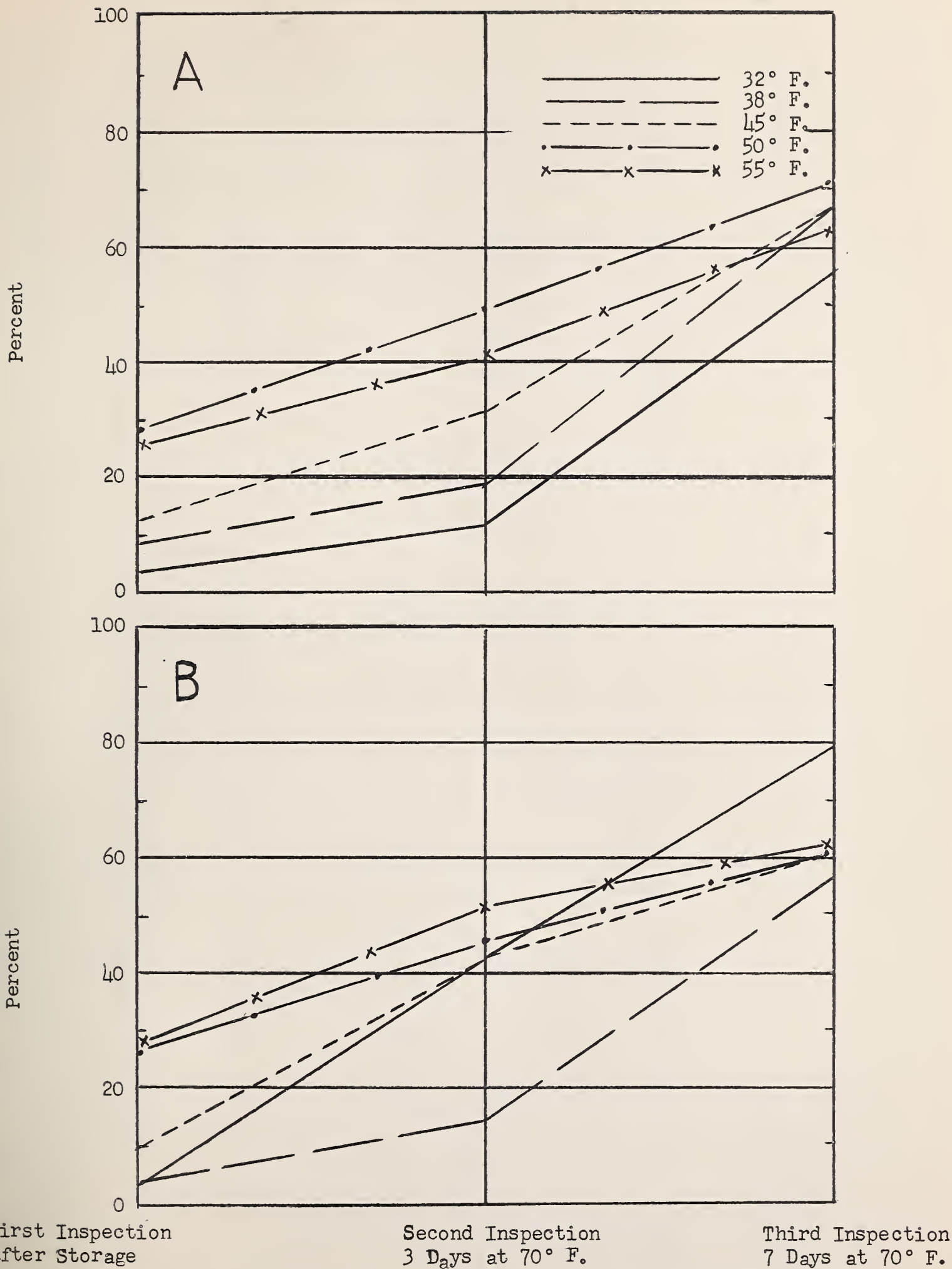


Figure 4. Effect of different storage temperatures on the development of decay during the holding period following 8 weeks' storage; A, Duncan grapefruit picked in April and in May; B, Marsh grapefruit picked in April and in May.

TABLE 1. Storage of April and May-pick grapefruit at Orlando, Florida, 1951. Results of inspections after four and eight weeks at temperatures of 32° and 50° F., followed by reinspections after three and seven days at 70°. Each line of data based on an average of six boxes of fruit.

Pick	Storage temperature	Storage period	Weight loss	First inspection after storage				Second inspection 3 days at 70° F. <u>1</u> /				Third inspection <u>1</u> / 7 days at 70° F.						
				Decay		Aging	Pitting	Decay		Aging	Pitting	Decay		Aging	Pitting			
				Severe	Moderate and severe			Stem-end	Penicillium			Total	Severe			Moderate and severe	Stem-end	Penicillium
					Percent					Percent					Percent			Total
Early	32°	4	1.8	0	1.5	0.3	0	1.9	0	4.9	1.1	0	4.2	0	4.8	1.6	15.3	21.6
"	32°	8	2.7	0	34.5	0	0	1.9	0.3	36.1	1.9	5.5	9.4	0	8.6	6.1	58.9	72.0
Late	32°	4	1.2	.2	2.6	0.5	0.3	0.9	0.2	10.2	0.5	0.3	2.5	0.2	4.3	1.1	41.5	45.6
"	32°	8	1.9	0	22.0	1.2	0.3	3.2	0.7	24.1	1.6	0.5	21.7	0	5.8	3.5	57.1	81.6
Early	50°	4	1.5	0	0	0	3.0	7.0	0	0.2	0	3.0	7.0	0	0.4	1.0	7.5	13.1
"	50°	8	4.9	0	0.3	7.6	16.2	28.1	0.2	0.2	9.3	20.2	34.7	0	0.5	11.7	27.6	46.5
Late	50°	4	1.1	0	1.4	2.1	4.7	9.4	0.5	0.9	2.3	5.1	13.9	0.2	1.1	3.6	13.3	23.9
"	50°	8	3.5	0	0.3	9.7	8.4	36.6	0	0.3	12.3	9.1	48.4	0	.5	13.4	14.4	60.7

^{1/} Decay data of second and third inspections accumulative. Pitting and aging data of second and third inspections not accumulative.

TABLE 2. Storage of Duncan and Marsh seedless grapefruit at Orlando, Florida, 1951. Results of inspections after four and eight weeks at temperatures of 32° and 50°, followed by reinspections after three and seven days at 70°. Each line of data based on an average of six boxes of fruit.

Variety	Storage temperature	Storage period Weeks	Weight loss	First inspection after storage				Second inspection 3 days at 70° F. <u>1</u> /				Third inspection 7 days at 70° F. <u>1</u> /							
				Pitting		Decay		Aging	Pitting	Decay		Aging	Pitting	Decay					
				Severe	Moderate and severe	Stem-end	Penicillium			Total	Severe			Moderate and severe	Stem-end	Penicillium	Total		
				Percent						Percent						Percent			
Duncan	32°	4	1.5	0.2	2.8	0.5	0	2.3	9.4	0.2	0.9	0	4.3	4.8	1.6	25.9	32.3		
"	32°	8	2.2	0	23.3	1.2	0	2.4	25.2	1.0	1.6	2.0	7.8	9.3	5.5	56.8	68.0		
Marsh	32°	4	1.5	0	1.3	0.3	0.3	0.5	5.7	0	0.7	0.3	2.4	4.3	1.1	30.9	34.9		
"	32°	8	2.4	0	33.1	0	0.3	2.7	35.0	0	1.9	4.0	23.2	5.1	4.1	59.2	85.7		
Duncan	50°	4	1.3	0	0.7	0.7	4.5	8.8	0.7	0.5	0.7	4.7	9.7	0.7	2.1	10.4	17.5		
"	50°	8	4.5	0	0.5	8.3	16.9	34.2	0	0	10.0	19.3	40.1	0.7	10.4	27.7	52.6		
Marsh	50°	4	1.3	0	0.7	1.4	3.2	7.6	0.5	0	1.6	3.5	11.3	0.9	2.5	10.4	19.5		
"	50°	8	3.8	0	0	9.0	7.7	30.5	0.5	0.2	11.6	9.9	43.0	0.2	14.7	14.3	54.6		

^{1/} Decay data of second and third inspections accumulative. Pitting and aging data of second and third inspections not accumulative.

TABLE 3. Storage of April and May-pick Duncan and Marsh seedless grapefruit at New York City, 1951. Results of inspections at arrival followed by reinspections after three and seven days at 70° F. Each line of data based on average of three boxes.

Variety		First inspection on arrival				Second inspection 3 days at 70° F.				Third inspection 7 days at 70° F.						
		Aging Pitting		Decay		Aging	Pitting		Decay		Aging and pitting ^{2/}	Decay				
		Severe	Moderate	Severe	Stem-end	Penicillium	Total	Severe	Moderate	Severe	Stem-end	Penicillium	Total	Commercial breakdown	Stem-end	Penicillium
Pick		Percent				Percent				Percent						
		0	1.9	0	0	0.5	0	2.3	0	0	2.3	2.3	4.7	0.9	4.7	5.6
		0.4	0	0.4	0	0	0.4	0	0	0	2.2	2.2	1.2	2.7	2.7	5.4
		0	2.3	0.9	0	2.3	0	3.3	2.3	0.9	2.3	3.2	5.1	0.9	3.7	4.6
Marsh		0	0.9	0.5	0	0.9	0	0	0	0.5	0.5	1.0	0	0.9	1.4	2.3
		Early	Late	Early	Late											

1/ Decay data of second and third inspections accumulative. Pitting and aging data of second and third inspections not accumulative.

2/ Commercial breakdown includes severe aging, and moderate and severe pitting.

TABLE 4. Storage of April and May-pick grapefruit at New York City, 1951. Results of inspections after four weeks at five different temperatures followed by reinspections after three and seven days at 70° F. Each line of data based on average of six boxes.

Pick	Storage temperature	First inspection after storage				Second inspection ₁ / 3 days at 70° F.				Third inspection ₁ / 7 days at 70° F.							
		Aging Pitting		Decay		Aging		Pitting		Aging and pitting ₂		Decay					
		Severe	Moderate	Severe	Stem-end	Penicillium	Total	Severe	Moderate	Severe	Stem-end	Commercial breakdown	Stem-end	Penicillium	Total		
Early	32°	0.5	1.6	0.7	2.1	1.6	3.7	0.5	6.1	0.9*	2.1	4.2	6.3	4.7	3.0	13.1	16.4
"	38°	0.2	7.2	6.8	0.5	1.9	2.6	1.4	12.4	15.0	0.7	4.0	4.9	22.2	1.9	19.4	21.3
"	45°	0.7	1.9	0.9	0.2	3.3	3.5	0.5	3.5	1.4	0.2	5.8	6.1	4.7	2.1	20.8	22.9
"	50°	0.2	0.9	0.2	0	2.6	2.6	0.5	2.6	1.2	0.5	4.4	4.9	4.4	0.5	17.8	18.2
"	55°	0	1.9	2.6	2.1	4.0	6.5	0	2.6	4.0	3.0	5.6	9.1	3.0	4.7	15.9	21.0
Late	32°	0	0.5	0.5	1.8	1.1	3.0	0	2.5	2.1	2.1	2.1	8.9	1.4	4.8	13.9	30.6
"	38°	0	1.4	1.1	1.4	2.1	3.4	0	4.1	3.4	1.8	2.3	4.8	3.2	4.1	13.2	22.4
"	45°	0.2	2.6	1.2	1.7	4.5	6.2	1.2	3.1	1.9	2.4	6.9	14.6	1.9	6.0	16.2	36.1
"	50°	0	1.4	1.4	3.1	3.6	6.9	0.5	1.4	1.0	4.5	5.7	12.9	1.2	8.1	16.5	29.9
"	55°	0	1.0	1.0	4.8	3.8	9.3	0.2	0.7	0.7	5.7	5.5	12.2	0.2	8.9	12.4	23.9
				Percent						Percent						Percent	
</																	

TABLE 5. Storage of Duncan and Marsh seedless grapefruit at New York City, 1951. Results of inspections after four weeks at five different temperatures followed by reinspections after three and seven days at 70° F. Each line of data based on average of six boxes.

Variety	Storage temperature	First inspection after storage				Second inspection 3 days at 70° F. <u>1</u> /				Third inspection 7 days at 70° F. <u>1</u> /					
		Aging		Pitting		Decay		Aging		Pitting		Decay			
		Severe		Moderate		Severe		Severe		Moderate		Severe			
		Stem-end		Penicillium		Total		Severe		Moderate		Severe			
Aging		Pitting		Decay		Aging		Pitting		Decay		Aging and pitting <u>2</u> /		Decay	
Severe		Moderate		Severe		Severe		Moderate		Severe		Commercial breakdown		Stem-end	
Penicillium		Total		Total		Total		Total		Total		Penicillium		Total	
Percent		Percent		Percent		Percent		Percent		Percent		Percent		Percent	
Duncan	32°	0	0.7	0.9	2.1	1.8	3.9	0.2	4.8	2.3	6.8	3.2	4.6	14.2	20.3
"	38°	0	2.5	1.6	1.4	3.2	4.8	0.5	5.7	5.0	6.4	6.2	4.7	17.8	20.8
"	45°	0.2	2.2	0.7	1.4	5.5	6.9	0.5	3.3	1.2	13.2	1.4	10.3	31.3	40.9
"	50°	0	1.2	1.4	2.2	3.8	6.2	1.0	3.1	1.2	10.5	2.4	7.2	26.6	33.0
"	55°	0	0.7	1.0	5.0	4.1	10.0	0	1.2	0.5	14.1	0.5	6.9	16.5	27.8
Marsh	32°	0.5	1.4	0.2	1.9	0.9	2.8	0.2	3.7	0.7	8.4	2.8	1.6	12.9	26.9
"	38°	0.2	6.1	6.3	0.5	0.7	1.2	0.9	10.7	13.3	3.3	19.2	1.4	14.7	23.1
"	45°	0.7	2.3	1.4	0.5	2.3	2.8	1.2	3.3	2.1	7.5	5.1	2.6	6.1	18.2
"	50°	0.2	1.2	0.2	0.9	2.3	3.3	0	0.9	0.9	7.2	3.3	3.0	7.9	15.2
"	55°	0	2.1	2.6	1.9	3.7	5.8	0.2	2.1	4.2	7.2	2.8	4.2	11.9	17.3

1/ Decay data of second and third inspections accumulative. Pitting and aging data of second and third inspections not accumulative.

2/ Commercial breakdown includes severe aging, and moderate and severe pitting.

TABLE 6. Storage of April and May-pick grapefruit at New York City, 1951. Results of inspections after eight weeks at five different temperatures, followed by reinspections after three and seven days at 70° F. Each line of data based on average of six boxes.

Pick	Storage temperature	First inspection after storage					Second inspection, 3 days at 70° F. <u>1</u> / <u>1</u>					Third inspection 1/7 days at 70° F. <u>1</u> / <u>1</u>					
		Aging		Pitting		Decay	Aging		Pitting		Decay	Aging and Pitting <u>2</u> / <u>1</u>		Decay			
		Severe	Moderate	Severe	Moderate		Severe	Stem-end	Penicillium	Total							
												Commercial breakdown	Stem-end		Penicillium	Total	
Percent					Percent					Percent							
Early	32°	0.2	15.2	19.2	0.7	1.6	2.6	0.2	11.7	25.2	2.8	2.6	17.5	15.0	7.0	34.8	60.0
"	38°	3.0	12.1	18.7	1.2	4.7	5.8	5.6	9.6	18.9	1.9	6.3	10.5	14.0	4.0	34.6	47.7
"	45°	4.2	3.5	1.9	5.4	4.0	9.6	3.5	4.9	1.9	7.7	4.7	23.4	4.4	12.6	17.3	46.7
"	50°	2.1	1.4	1.2	4.7	11.2	15.9	0.9	1.2	0.9	10.5	11.9	28.0	1.4	14.3	24.1	47.2
"	55°	0.2	1.2	0	11.4	9.3	20.8	0	0.2	0	12.9	11.4	35.0	0.9	14.7	26.9	54.9
Late	32°	0	5.0	8.7	1.8	1.8	3.7	0.2	8.0	8.4	2.1	1.8	35.4	8.7	3.9	32.6	74.2
"	38°	5.1	8.2	14.3	2.3	2.8	5.4	5.1	8.9	14.7	3.3	4.7	22.0	7.9	10.3	38.1	75.2
"	45°	3.6	4.5	3.3	3.1	6.0	12.4	2.4	2.9	2.9	8.6	10.3	50.5	3.8	15.8	26.8	81.1
"	50°	1.4	1.0	0	8.4	18.4	38.5	0.2	0.5	0.5	11.7	21.1	66.5	0.5	14.4	34.9	85.4
"	55°	0	0.2	0.7	14.3	5.9	35.0	0	0.7	0.2	15.5	8.1	58.1	0.2	18.5	16.7	71.7

1/ Decay data of second and third inspections accumulative. Pitting and aging data of second and third inspections not accumulative.

2/ Commercial breakdown includes severe aging, and moderate and severe pitting.

TABLE 7. Storage of Duncan and Marsh seedless grapefruit at New York City, 1951. Results of inspections after eight weeks at five different temperatures followed by reinspections after three and seven days at 70° F. Each line of data based on average of six boxes.

Variety	Storage temperature	First inspection after storage					Second inspection <u>1/</u> 3 days at 70° F.					Third inspection <u>1/</u> 7 days at 70° F.				
		Aging		Pitting		Decay			Aging		Pitting		Decay			
		Severe	Moderate	Severe	Moderate	Severe	Stem-end	Penicillium	Total	Aging and pitting	Commercial breakdown	Stem-end	Penicillium	Total		
															Decay	
Percent																
Duncan	32°	0.2	10.3	15.8	1.4	3.9	0.2	11.6	18.5	3.0	11.4	14.2	5.0	41.6	55.5	
"	38°	2.3	7.7	14.5	1.6	8.4	3.7	8.9	11.7	2.3	18.2	5.8	5.4	46.0	56.6	
"	45°	3.6	4.3	3.6	4.3	12.4	3.3	4.8	3.3	9.1	31.3	4.5	16.0	31.8	57.0	
"	50°	2.4	0.7	0.7	6.5	28.0	0.5	1.0	1.2	11.2	48.8	1.7	13.9	35.4	71.3	
"	55°	0.2	0.5	0	14.0	25.9	0	0.5	0	15.0	41.1	0.7	17.2	31.0	63.8	
Marsh	32°	0	9.8	11.9	1.2	2.3	0.2	7.9	15.0	1.9	42.1	9.3	5.8	25.7	79.2	
"	38°	5.8	12.6	18.5	1.9	2.8	7.0	9.6	22.0	2.8	14.3	16.1	8.9	26.6	56.3	
"	45°	4.2	3.7	1.6	4.2	9.6	2.6	3.0	1.4	7.2	42.1	3.7	12.4	12.4	60.5	
"	50°	1.2	1.6	0.5	6.5	26.2	0.7	0.7	0.2	11.0	45.3	0.2	14.7	23.6	61.0	
"	55°	0	0.9	0.7	11.7	27.1	0	0.5	0.2	13.3	51.2	0.5	15.9	13.3	62.4	

1/ Decay data of second and third inspections accumulative. Pitting and aging data of second and third inspections not accumulative.

2/ Commercial breakdown includes severe aging, and moderate and severe pitting.

TABLE 8. Commercial storage of grapefruit, 1951

Car	Variety	Location of storage warehouse	Storage period	Weeks in storage	Condition of fruit at end of storage	Sale price per box	Location of sale
1	Duncan	New York	4/23-6/2	5½	Very good <u>1/</u>	\$1.74	Boston
2	Marsh	"	4/25-6/2	5½	Good <u>2/</u>	\$2.06	"
3	"	Providence	4/27-5/22	3½	Very good	\$3.20	"
4	"	New York	4/30-5/25	3½	Good	\$1.52	New York
5	Duncan	"	5/1- 5/23	3	Very poor <u>3/</u>	\$1.72	"
6	Marsh	Providence	5/2- 6/12	6	Poor <u>4/</u>	\$1.56	Boston
7	"	"	5/23-6/17	3½	Good	\$3.75	"
8	"	New York	5/23-6/20	4	Excellent	\$3.00	"
9	"	"	5/24-7/11	7	Fair	\$1.96	New York
10	"	"	5/31-6/28	4	Fair to poor	\$1.28	"
11	"	Providence	6/7- 7/17	1½	Very poor <u>3/</u>	\$2.89	"
12	"	New York	6/13-7/11	4	Poor to very poor <u>5/</u>	\$1.40	"

1/ Final inspection made three weeks after date stored.

2/ Final inspection made four weeks after date stored.

3/ Fruit in very poor condition at time of storage.

4/ Fruit in poor condition at time of storage. Final inspection made 3 weeks after date stored.

5/ Fruit in fair to poor condition at time of storage.

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